

ARIKETAK. LEHENENGO ZATIA (1, 2, 3 . Gaiak).

- 1) Oinarritzko Zirkuitu digitalak erabiliz, kotxearen segurtasun-uhalerako alarma sistema diseinatu ezazu. Sistemak detektatu behar izango du kotxea martxan jarri dugunean eta segurtasun-uhala jarrita ez dugunean.

$$f = \bar{A}B$$

- 2) Oinarritzko zirkuitu digitalak erabiliz, etxearen gelarako arrotz-detektagailu sistema diseinatu ezazu. Horretarako sentsoareak gelako bi leihoetan eta atean izango ditugu. Leihoa edo atea zabaltzen direnean sentsoare hauek maila altuko irteera ematen dute

$$f = A + B + C$$

- 3) Garatu ondorengo adierazpenak, modu kanonikoa lortu arte:

$$f_1 = \bar{A}\bar{C} + A\bar{C}D + \bar{A}BCD \quad \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + \bar{A}BCD$$

$$f_2 = \bar{A}\bar{C}D + AC + ABC \quad \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + \bar{A}BCD$$

$$f_3 = \bar{A}B + AC \quad \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}BC$$

$$f_4 = (\bar{B} + \bar{D})(\bar{B} + A)(C + \bar{D})(\bar{D} + A)$$

$$f_5 = (X_1 + X_3)(X_3 + X_2X_4) + (X_3X_5 + (X_1 + X_4)(X_2 + \bar{X}_3))$$

- 4) Karnaugh-en mapak erabiliz, adierazi eta sinplifika itzazu ondorengo funtzioak.

a) $f_1 = (1, 3, 9, 10, 12, 13, 14, 15)_m \quad \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD$

b) $f_2 = (0, 2, 3, 4, 5, 7, 8, 10, 11)_m \quad \bar{B}\bar{C} + \bar{A}\bar{B}D + \bar{A}\bar{C}\bar{D} + \bar{B}\bar{C}\bar{D}$

c) $f_3 = (1, 6, 7)_m \quad AB + \bar{A}\bar{B}C$

d) $f_4 = (0, 1, 6)_m \quad (A + B)(\bar{A} + \bar{B} + C)$

e) $f_5 = (0, 1, 2, 3, 7, 8, 9, 11, 15)_m + K(6, 12) \quad \bar{A}\bar{B} + CD + \bar{A}C + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}C$

f) $f_6 = (3, 6, 7, 8, 10)_m + K(12, 13, 14) \quad \bar{A}\bar{C}D + \bar{A}BC + A\bar{D} + \bar{A}B\bar{C}$

g) $f_7 = (0, 1, 4, 5, 7, 8, 10, 15)_m + K(2, 6, 14) \quad \bar{A}\bar{E} + BC + C\bar{D} + \bar{A}\bar{B}\bar{D}$

h) $f_8 = (0, 1, 4, 5, 6, 7, 12, 13, 14, 16, 17, 28, 29)_m + K(10, 11, 22, 23, 25, 26, 30, 31) \quad \bar{A}\bar{C}\bar{D} + \bar{A}C\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}B\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D}$

- 5) NAND logika erabiliz osa itzazu ondorengo adierazpenak:

a) $ABC + DE$

b) $ABC + \bar{D} + \bar{E}$

c) ABC

d) $\bar{A}\bar{B} + \bar{C}\bar{D}$

e) $(A + B)(C + D)$

f) $AB[C(DE + \bar{A}\bar{B}) + \bar{B}\bar{C}\bar{E}]$

g) $B(CDE + \bar{E}FG)(\bar{A}\bar{B} + C)$

- 6) Familia logiko ezberdinen ezaugarriak adierazgarrienak ondorengo taulan agertzen dira. Lor itzazu zarata-tarteak eta fan-out:

	TTL	TTL LS	TTL ALS	CMOS
V _{cc}	5V	5V	5V	3V-18V
V _{IH}	2.0	2.0	2.0	3.5
V _{IL}	0.8	0.8	0.8	1.5
V _{OH}	2.4	2.7	2.7	4.5
V _{OL}	0.4	0.5	0.4	0.5
I _{IH} μ A	40	20	20	0.005
I _{IL} mA	-1.6	-0.36	-0.2	-0.005 μ A
I _{OH} μ A	-400	-400	-400	-360
I _{OL} mA	16	8	4	4

- 7) Zirkuitu inpresio batetan TTL Standar-arekin egindako txip bat daukagu. Posiblea litzateke Txip horren ordeztu TTL LS edo TTL AS txip bat jartzea?

- 8) Bidegurutze batetako semaforoen funtzionamendua, ondorengo baldintzetan datza:

- A kalean kotxe bat baldin badago, orduan kale horretako semaforoa berde dago.
- B kalean kotxe bat baldin badago, orduan kale horretako semaforoa berde egongo da baldin eta A kalean kotxerik ez badaude.
- C kalean kotxe bat baldin badago, orduan kale horretako semaforoa berde egongo da baldin eta A eta B kaleetan kotxerik ez badaude.
- Kotxerik ez badaude, semaforo guztiak gorri daude.

Egitaula erabiliz, adieraz ezazu antolaketa honi dagokion funtzio logikoa (gorri = 1).

- 9) Entrepresa baten akzioak ondoren adierazten den moduan banatuta dituzte lau bazkideen artean:

$$A = 35\% \quad B = 30\% \quad C = 25\% \quad D = 10\%$$

Proposamen bat hautatu nahi denean, botuen arabera aurrera joango den ala ez jakiteko diseinatu ezazu funtzio logikoa.

$$Y = AB + AC + BC$$

- 10) Prozesu kimikoak egiten diren entrepresa batetan, hiru elementu kimiko ezberdin erabiltzen dira. Hiru elementu hauek hiru biltegi ezberdinetan gordetzen dira. Biltegi bakoitzean, elementu bakoitzaren maila adierazteko sensore bat dago. Likidoaren maila, adierazitako puntu baten azpitik dagoenean, sensoreak tentsio altua sortarazten du.

$$Y = \bar{A}BC + A\bar{B}C + AB$$

Biltegi bakoitzean elementu kimiko bakoitzaren maila, monitore batetan ikusgarri izan dadin, diseinatu ezazu zirkuitu bat, zeinak seinale bat emago duen bi biltegien maila, adierazitako puntuaren azpitik agertzen denean.

- 11) Diseinatu ezazu lau aldagai dituen zirkuitu logiko bat, zeinak 1 sortuko duen irteeran, sarreran hiru aldagai 1 direnean.

$$Y = BCD + ACD + ABD + ABC$$

- 12) Igogailu baten funtzionamenduan akatsik dagoen, detektatzen duen sistema diseinatu nahi da, zeinak ondoko baldintzak bete behar dituen:

- Igogailua matxan jartzen denean, atea itxita egon behar da.
- Hutsik badago eta eskaerarik ez badago, ez da mugitu behar.
- Geldirik badago, atea zabalik.

$$\bar{A}B + AB + A\bar{C}\bar{D}$$

- 13) Zirkuitu logiko batek, 5 sarbide eta irtenbide 1 du. Bost sarbidetatik, lauk digito hamartar bat adieraten dute eta bostgarrena kontrolerako digitoa da. Kontrol-digito hau 0 logikoan dagoenean, irteera 0 logikoa izango da hamartarra zenbaki bikoitia baldin bada, eta irteera 1 izango da bakoitia baldin bada. Kontrol-digitoa 1 logikoan dagoenean, irteera 0 izango da, sarrera hiruren anizkoitza denean. Diseinatu ezazu zirkuitua.

ARISKE TAK. LEHENERENGO HANTA (1,2,3. Gacik) - 001

- 1) A → segitiga, cilele
B → merbau, gumi

A	B	F
0	0	0
0	1	1
1	0	0
1	1	0

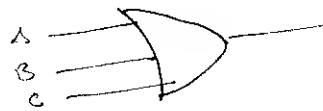
~~$f = \bar{A}B$~~

$$f = \bar{A}B$$

- 2) A → 1 leman
B → 2 leman
C → uter

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

$$f = A + B + C$$



- 4) Karnaugh ven bider simplifikasi

a) $f_1 = (1, 3, 5, 10, 12, 13, 14, 15)_m$

0001
0011
1001
1010
1100
1101
1011
1111

$$\bar{A}\bar{B}D + A\bar{C}D + AC\bar{D} + AB$$

AB \ CD	00	01	11	10
00		1	1	
01				
11	1	1	1	1
10		1		1

$$(A\bar{B}\bar{C}D + A\bar{B}CD + A\bar{B}C\bar{D} + A\bar{B}CD)$$

b) $f_2 = (0, 2, 3, 4, 5, 7, 8, 10, 11)_m$

0000
0010
0011
0100
0101
0111
1000
1001
1010
1011

AB \ CD	00	01	11	10
00	1			1
01	1	1	1	
11				
10	1		1	1

$$\bar{B}C + \bar{A}BD + A\bar{C}\bar{D} + \bar{B}\bar{C}\bar{D}$$

c) $f_3 = (1, 6, 7)_m$

001
110
111

AB \ C	0	1
00		1
01		
11	1	1
10		

$$AB + \bar{A}\bar{B}C$$

$$3) f_1 = \begin{matrix} 0000 & 1001 & 0111 \\ 0001 & 1101 & \\ 0100 & & \\ 0101 & & \end{matrix}$$

$$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + \bar{A}B\bar{C}D$$

$$f_2 = \begin{matrix} 0000 & 1010 & 1111 \\ 0100 & 1011 & 1111 \\ & 1110 & \\ & 1111 & \end{matrix}$$

$$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D$$

$$f_3 = \begin{matrix} 0100 & 1010 \\ 0101 & 1011 \\ 0110 & 1110 \\ 0111 & 1111 \end{matrix} \quad \begin{matrix} 010 & 101 \\ 011 & 111 \end{matrix}$$

$$\bar{A}B\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + A\bar{B}\bar{C}$$

$$f_4 = \begin{matrix} 0101 & 0100 & 0001 & 0000 \\ 0110 & 0110 & 0101 & 0011 \\ 1101 & 0110 & 1001 & 0101 \\ 1111 & 0111 & 1101 & 0111 \end{matrix} \quad \Pi(1, 3, 4, 5, 6, 7, 9, 13, 15)$$

$$(A+B+C+D)(A+B+C+\bar{D})(\bar{A}+\bar{B}+C+D)(A+\bar{B}+C+\bar{D})(A+\bar{B}+C+D)(\bar{A}+\bar{B}+C+\bar{D})(\bar{A}+\bar{B}+C+\bar{D}) \cdot (A+B+C+D)(\bar{A}+\bar{B}+C+\bar{D})(A+B+C+\bar{D})$$

$$f_5 = \bar{K}_3 \cdot \bar{K}_2 \cdot K_4 \cdot \bar{K}_3 (K_2 + K_4)$$

$$4) f_4 = (0, 1, 6)M$$

$$\begin{matrix} 000 \\ 001 \\ 110 \end{matrix}$$

AB	0	1
00	0	0
01		
11	0	
10		

$$\bar{A}\bar{B} + \bar{A}\bar{B}\bar{C}$$

$$(A+B)(\bar{A}+\bar{B}+C)$$

$$9) A=35\% \quad B=30\% \quad C=25\% \quad D=10\%$$

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$$\Sigma(6, 7, 10, 11, 12, 13, 14, 15)$$

$$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D$$

$$\bar{A}\bar{B}\bar{C}(\bar{D}+D) + A\bar{B}\bar{C}(\bar{D}+D) + A\bar{B}\bar{C}(\bar{D}+D) + A\bar{B}\bar{C}(\bar{D}+D)$$

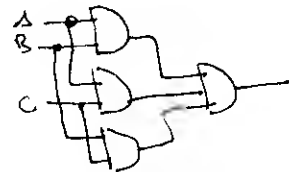
$$[\bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + A\bar{B}\bar{C} + A\bar{B}\bar{C}]$$

$$[\bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + A\bar{B}\bar{C}]$$

$$B(A+\bar{A}) + A\bar{B}\bar{C}$$

$$B\bar{A} + B\bar{C} + A\bar{B}\bar{C}$$

$$A(B+\bar{B}\bar{C}) \quad \boxed{A\bar{B} + A\bar{C} + B\bar{C}}$$



ACIKETAY. LEHENGUNGO PATIA (1,2,3. Gvay) - 002

3) A → kotree → berde
er → guri

B → ~~kotree~~ ~~berde~~ kotree → A guri → berde

C → kotree → A guri → B kotree

A → kotree → berde

B → kotree
A kotree er berde

C → kotree
A kotree er berde
B kotree er

Kotree kotree → guri

guri = 1
berde = 0

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

0 → kotree er
1 → kotree bai

A	B	C	S _A	S _B	S _C
0	0	0	1	1	1
0	0	1	1	1	0
0	1	0	1	0	0
0	1	1	1	0	1
1	0	0	0	1	1
1	0	1	0	1	1
1	1	0	0	1	1
1	1	1	0	1	1

$$S_A = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}BC$$

$$S_B = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + A\bar{B}C$$

$$S_C = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}BC + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$$

$$S_C = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}BC + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$$

1) Bi segurtasun uhaletan.

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

$$\bar{A}\bar{B}C + \bar{A}BC + A\bar{B}\bar{C}$$

$$\bar{A}(\bar{B}C + BC) + AC(\bar{B} + B)$$

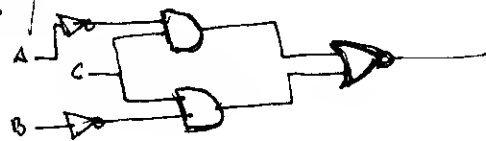
$$\bar{A}C(\bar{B} + B) + AC$$

$$C(\bar{A} + A) \rightarrow F = C$$

$$\bar{A}[C(\bar{B} + B)] + A\bar{B}C$$

$$\bar{A}C + A\bar{B}C$$

$$C(\bar{A} + A\bar{B}) \quad \boxed{C\bar{A} + C\bar{B}}$$



$$8) \bar{A}\bar{B}(\bar{C} + C) + \bar{A}[B(\bar{C} + C)]$$

$$\bar{A}(\bar{B} + B) \rightarrow \boxed{F = \bar{A}} \quad S_A$$

$$\bar{A}\bar{B}(\bar{C} + C) + A[\bar{B}(\bar{C} + C)] + AB(\bar{C} + C)$$

$$\bar{A}\bar{B} + A\bar{B} + AB \quad \bar{A}\bar{B} + A \quad \boxed{F = A + \bar{B}} \quad S_B$$

$$(\bar{A}\bar{B}(\bar{B} + B) + A(\bar{B}C + \bar{B}\bar{C}) + AB(\bar{C} + C))$$

$$\bar{A}\bar{B} + AC + AB$$

$$\bar{A}\bar{B}(\bar{B} + B) + BC(\bar{A} + A) + A\bar{B}(\bar{B} + B) + A\bar{B}C$$

$$\bar{A}\bar{B} + BC + A\bar{B} + A\bar{B}C$$

$$C(\bar{B} + A\bar{B}) \rightarrow C\bar{B} + CA$$

$$\bar{A}\bar{B} + A\bar{B} + AC + BC$$

$$\bar{A}\bar{B} + A(\bar{B} + C) + BC$$

$$A + \bar{B} + BC \quad \boxed{F = A + \bar{B} + B} \quad S_C$$

10) $A \rightarrow \text{behave} \rightarrow 1$

$B \rightarrow \text{behave} \rightarrow 1$

$C \rightarrow \text{behave} \rightarrow 1$

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$$f = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

$$\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

$$f = AB + AC + BC$$

11)

A	B	C	D	F
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$$\bar{A}BCD + A\bar{B}CD + AB\bar{C}D + ABC\bar{D} + ABCD$$

$$f = BCD + ACD + ABD + ABC$$

12) $\{ \text{nicht leer} \cdot \text{anteile} \}$
 $\{ \text{nicht leer} \cdot \text{erhalten} \} \rightarrow \text{selbst}$

4. e) $f_1 = \{0, 1, 2, 3, 7, 8, 9, 11, 15\}_m + \{6, 12\}$

- 0000
- 0001
- 0010
- 0011
- 0111
- 1000
- 1001
- 1011
- 1111
- 0110
- 1100

AB \ CD	00	01	11	10
00	1	1	1	1
01			1	1
11	1	1	1	
10	1	1	1	

$$\bar{A}\bar{B} + CD + \bar{A}C + A\bar{C}\bar{D} + A\bar{B}\bar{C}$$

f) $f_2 = \{3, 6, 7, 8, 10\}_m + \{12, 13, 14\}$

- 0011
- 0110
- 0111
- 1000
- 1010
- 1100
- 1101
- 1110

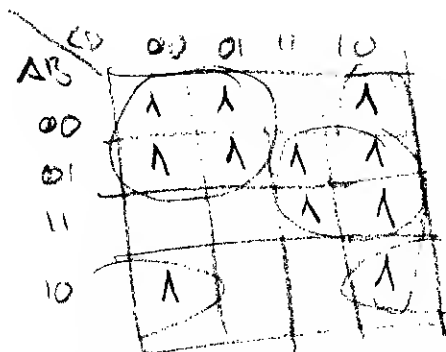
AB \ CD	00	01	11	10
00			1	
01			1	1
11	1	1		1
10	1			1

$$\bar{A}CD + \bar{A}BC + A\bar{D} + A\bar{B}\bar{C}$$

Rekurse

4) $f_1 = (0, 1, 4, 5, 7, 8, 10, 15) \sim + K(2, 6, 14)$

0000
0001
0100
0101
0111
1000
1010
1111
0010
0110
1110

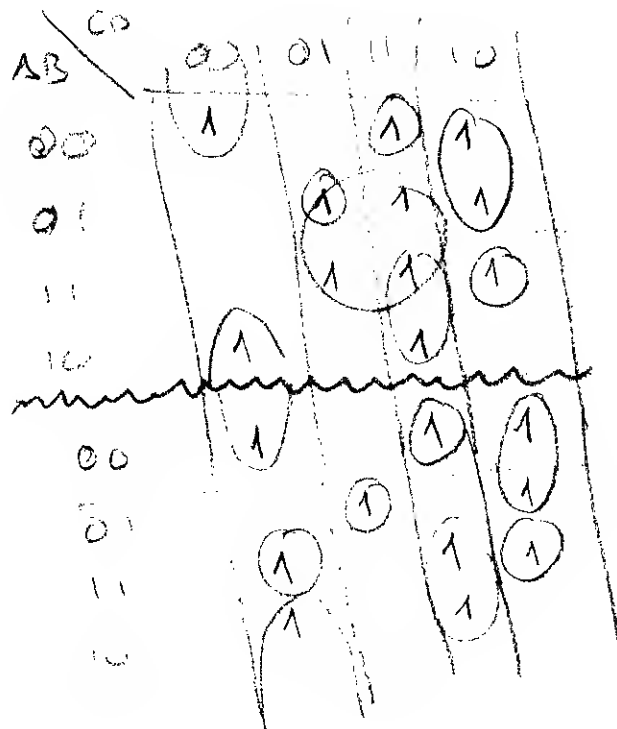


$$\bar{A}\bar{C} + BC + C\bar{D} + A\bar{B}\bar{D}$$

h) $f_2 = (0, 1, 4, 5, 6, 7, 12, 13, 14, 16, 17, 28, 29) \sim + K(10, 11, 22, 23, 25, 26, 30, 31)$

2, 3, 8, 9, 10, 11, 15, 18, 19, 20, 21, 27, 28

0 00000 00010 10
1 00001 01011 11
4 00000 10110 22
5 00101 10111 23
6 00110 11001 25
7 00111 11010 26
12 01000 11110 30
13 01001 11111 31
16 10000
17 10001
28 11100
29 11101



$$E = 0$$

$$E = 1$$

$$\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D}$$

$$\bar{A}\bar{C}\bar{D} + A\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + \bar{B}\bar{C}\bar{D} + B\bar{C}\bar{D}$$

12) Karten bilden ableiten

ablesen = 1

hulstik oder eskalationen → gelöst

gelöst → ableiten

A → netzen = 1
B → ableiten = 1
C → hulstik = 0
D → eskalation = 1

A	B	C	D	F
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

- 12) $A \rightarrow \text{master} = 1$
 $B \rightarrow \text{alter zulässig} = 1$
 $C \rightarrow \text{hutsik} = 0$
 $D \rightarrow \text{elakra} = 1$

AB \ CD	00	01	11	10
00				
01	0	0	0	0
11				
10		0	0	0

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

1 \rightarrow erlaubt
 0 \rightarrow nicht erlaubt

AB \ CD	00	01	11	10
00	1	1	1	1
01				
11	1	1	1	1
10	1			

$$\bar{A}\bar{B} + A\bar{B} + A\bar{C}\bar{D}$$

$$(A + \bar{B})(\bar{A} + B + \bar{D})(\bar{A} + B + \bar{C})$$

- 13) $A \ B \ C \ D \ E \ F$

Originalkennzeichen
 Kontrolle
 Original

Kontrolle = 0 / Original F = 0
 Kennzeichen = bitweise

Kontrolle = 0
 Kennzeichen = bitweise / Original F = 1

Kontrolle = 1 / Original F = 0
 Kennzeichen = 3.7

A B C D	E=0	E=1
0000	X	X
0001	1	X
0010	0	X
0011	1	0
0100	0	X
0101	1	X
0110	0	0
0111	1	X
1000	0	X
1001	1	0
1010	0	X
1011	1	X
1100	0	0
1101	1	X
1110	0	X
1111	1	0

AB \ CD	00	01	11	10
00	X	1	1	0
01	0	1	1	0
11	0	1	1	0
10	0	1	1	0

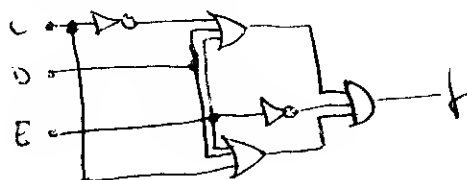
E=0

AB \ CD	00	01	11	10
00	X	X	0	X
01	X	X	X	0
11	0	X	0	X
10	X	0	X	X

E=1

$$F = \bar{D}\bar{E} + [\bar{B}\bar{D} + \bar{A}\bar{C} + A\bar{B}\bar{C} + B\bar{C}\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{D}]$$

~~F = (Kennzeichen) Kennzeichen = 3.7~~ $\bar{D}\bar{E}$



6) Zerake. berake

$$\text{TL} \quad V_{NH} = 0.4V$$

$$V_{NL} = 0.4V$$

fan-out = 10 ate

$$\text{TL LS} \quad V_{NH} = 0.7V$$

$$V_{NL} = 0.3V$$

fan-out = 20 ate

$$\text{TL ALS} \quad V_{NH} = 0.7V$$

$$V_{NL} = 0.4V$$

fan-out = 10 ate

$$\text{CMOS} \quad V_{NH} = 1V$$

$$V_{NL} = 1V$$

fan-out = 12K ate

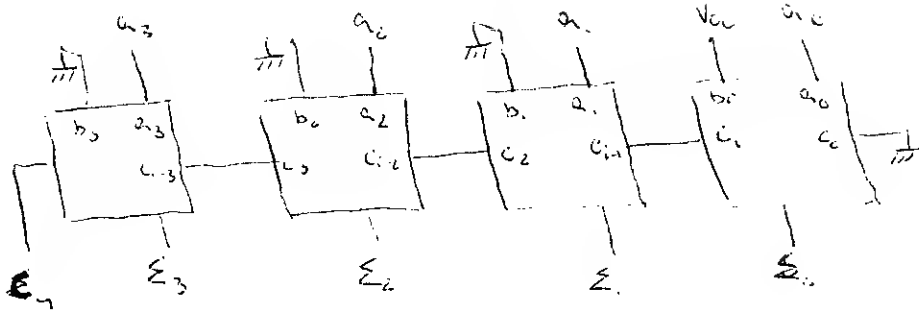
$$V_{NH} = V_{OHmin} - V_{OLmin}$$

$$V_{NL} = V_{OHmax} - V_{OLmax}$$

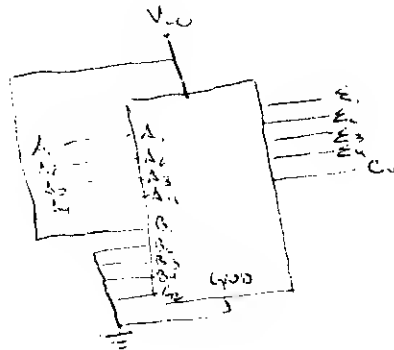
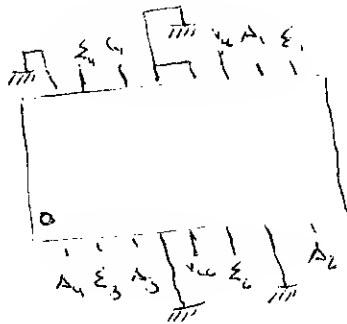
4) TL estenderaren baten TL LS eta TL AS?

Bas Sarrera neuria berdina da bira berria

14)



7483 integratua erabiltu



15)

A-B kalkulatu

2ko osagarria

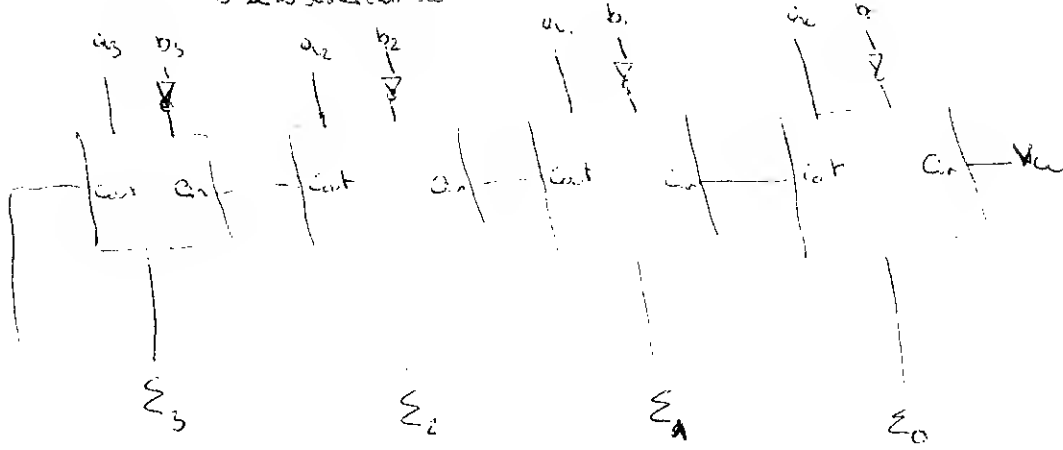
A-B < 0 → erantza negatiboa
→ erantza positiboa

2ko osagarria

$$A - B = A + (\overline{B} + 1)$$

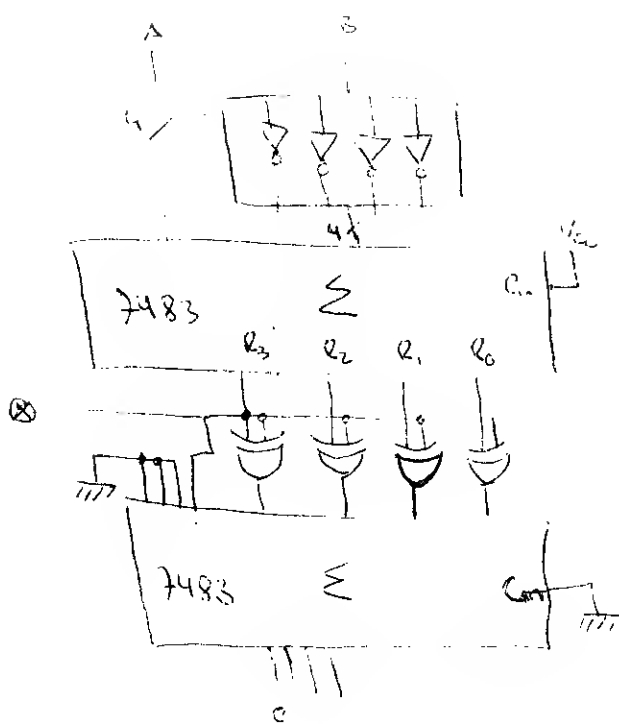
4 digitu → 1 zerua sartu

3 zeru bikoiztenak



Σ3 → 0 positiboa
Σ3 → 1 negatiboa

Σ3 = 1, negatiboa denbatur, 2ko osagarria erabiltu. Datasheet ikusatu.

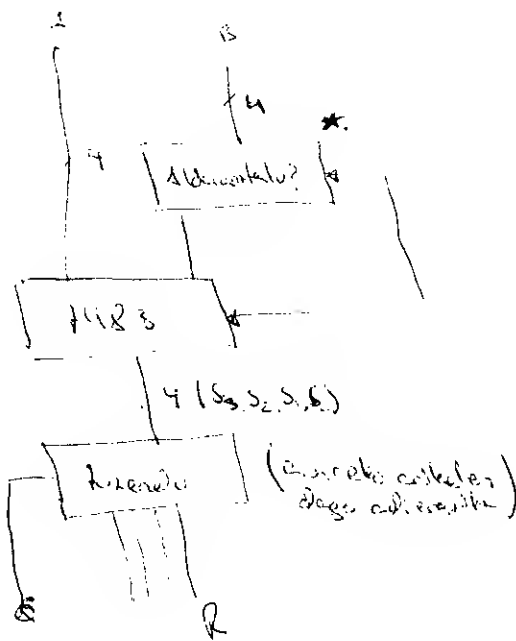


a_3	a_2	Aldeerskato	Finke
0	0	0 er	
0	1	1 er	
1	0	1 hal	
1	1	0 bal	

16) $A, B \geq 0$ bevir a_3, b_3 resimato bittet

$A, B \in [-8, 7]$

Ubbet bevirat aittet, aittet aittet aittet (adib: 2+3.4)



1. bittet / bittet

* $b_3 \oplus [S/R]$

b_3	S/R	
0	0	0
0	1	1
1	0	1
1	1	0

ef flow aittet aittet

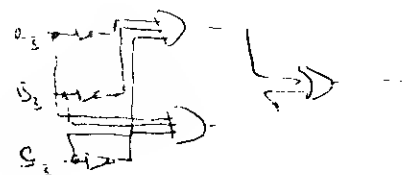
a_3	b_3	S_3	Overfla
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

bevirat aittet aittet

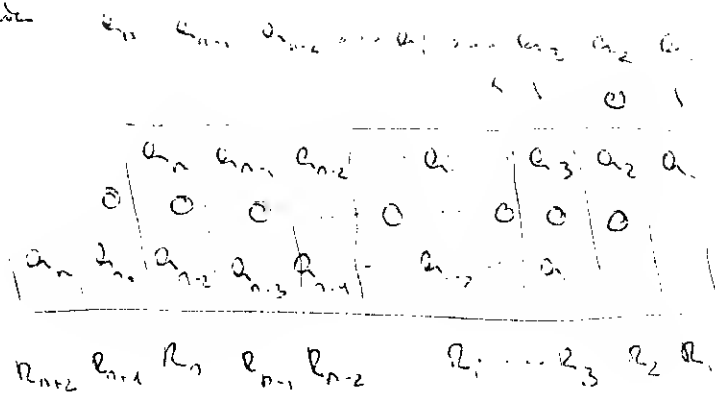
bevirat aittet aittet aittet aittet

$S=0$ bevir aittet aittet aittet
 $S=1$ bevir aittet aittet aittet aittet

$$OV = a_3 b_3 S_3 + a_3 b_3 \bar{S}_3$$



17) n bitte kombinator



$$R_1 = a_1$$

$$R_2 = a_2$$

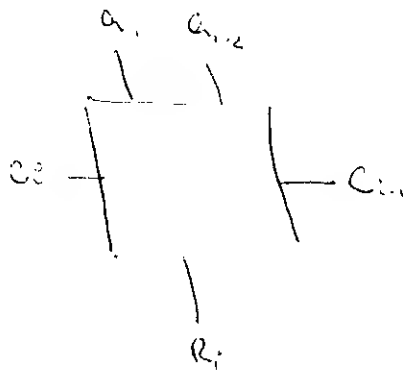
$$R_3 = a_3 + C_1$$

$$R_i = a_i + a_{i-1} + C_{i-1}$$

$$R_n = a_n + a_{n-1} + C_{n-1}$$

$$R_{n+1} = a_{n+1} + C_n$$

$$R_{n+2} = a_{n+2} + C_{n+1}$$



a_1	a_2	C_1	C_2	R_1
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	0	0
1	0	0	0	1
1	0	1	0	0
1	1	0	1	0
1	1	1	1	1

1. Kapselung beidseitig von 0 bis 100
 $R_1 = 1$ bis 100

$$R_1 = a_1 \oplus a_2 \oplus C_1$$

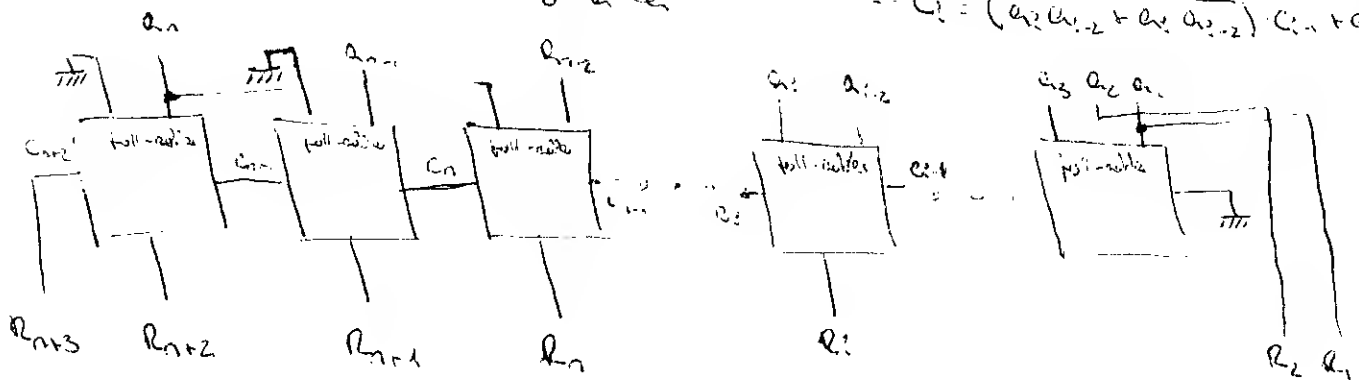
$$C_1 = \bar{a}_1 a_2 C_1 + a_1 \bar{a}_2 C_1 + a_1 a_2 \bar{C}_1 + a_1 a_2 C_1$$

$$C_1 = \bar{a}_1 a_2 C_1 + a_1 \bar{a}_2 C_1 + a_1 a_2 \bar{C}_1 + a_1 a_2 C_1$$

$$C_1 = (\bar{a}_1 a_2 + a_1 \bar{a}_2) C_1 + a_1 a_2$$

$$C_1 = (a_1 \oplus a_2) C_1 + a_1 a_2$$

Korrekter



18)

$$a_1, a_2$$

$$b_1, b_2$$

$$a_1, a_2, a_3, a_4$$

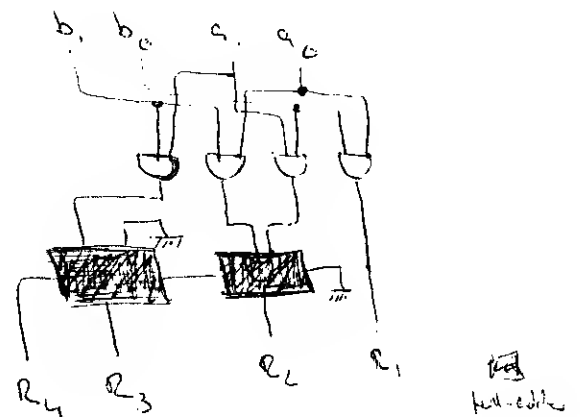
$$a_1, b_1, a_2, b_2$$

$$R_1 = a_1 b_1$$

$$R_2 = a_1 a_2 + a_2 b_1$$

$$R_3 = a_1 b_1 + C_{12}$$

$$R_4 = C_{23}$$



$a_5 \ a_4 \ a_3 \ a_2 \ a_1 \ a_0$

$b_5 \ b_4 \ b_3 \ b_2 \ b_1 \ b_0$

$a_5b_0 \ a_4b_1 \ a_3b_2 \ a_2b_3 \ a_1b_4 \ a_0b_5$

$a_5b_1 \ a_4b_2 \ a_3b_3 \ a_2b_4 \ a_1b_5 \ a_0b_6$

$a_5b_2 \ a_4b_3 \ a_3b_4 \ a_2b_5 \ a_1b_6 \ a_0b_7$

$a_5b_3 \ a_4b_4 \ a_3b_5 \ a_2b_6 \ a_1b_7 \ a_0b_8$

$a_5b_4 \ a_4b_5 \ a_3b_6 \ a_2b_7 \ a_1b_8 \ a_0b_9$

$a_5b_5 \ a_4b_6 \ a_3b_7 \ a_2b_8 \ a_1b_9 \ a_0b_{10}$

$a_5b_6 \ a_4b_7 \ a_3b_8 \ a_2b_9 \ a_1b_{10} \ a_0b_{11}$

$R_8 \ R_7 \ R_6 \ R_5 \ R_4 \ R_3 \ R_2 \ R_1 \ R_0$

$$R_0 = a_0b_0$$

$$R_1 = a_1b_0 + a_0b_1$$

$$R_2 = a_2b_0 + a_1b_1 + a_0b_2$$

$$R_3 = a_3b_0 + a_2b_1 + a_1b_2 + a_0b_3$$

$$R_4 = a_4b_0 + a_3b_1 + a_2b_2 + a_1b_3 + a_0b_4$$

$$R_5 = a_5b_0 + a_4b_1 + a_3b_2 + a_2b_3 + a_1b_4 + a_0b_5$$

$$R_6 = a_5b_1 + a_4b_2 + a_3b_3 + a_2b_4 + a_1b_5 + a_0b_6$$

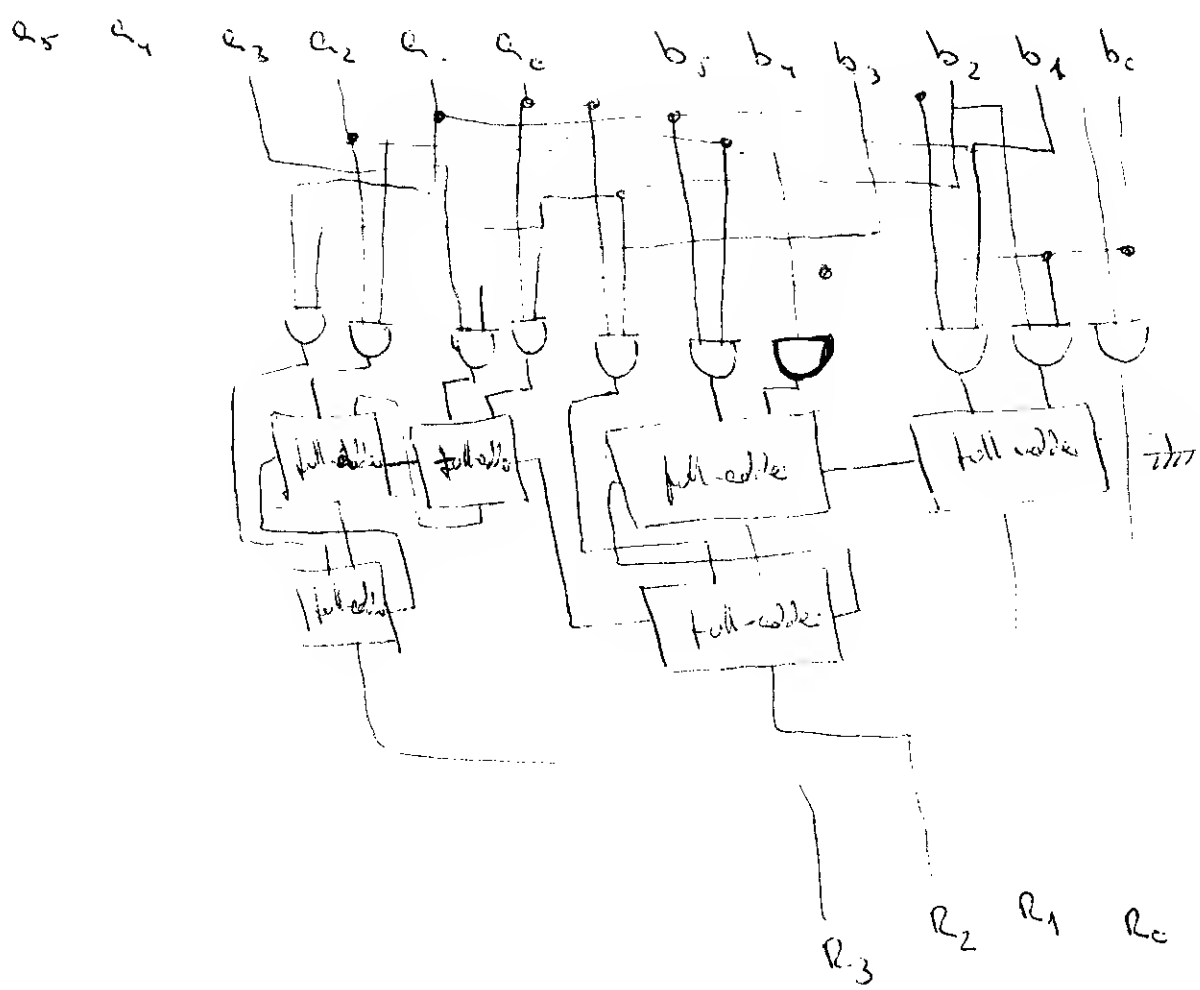
$$R_7 = a_5b_2 + a_4b_3 + a_3b_4 + a_2b_5 + a_1b_6 + a_0b_7$$

$$R_8 = a_5b_3 + a_4b_4 + a_3b_5 + a_2b_6 + a_1b_7 + a_0b_8$$

$$R_9 = a_5b_4 + a_4b_5 + a_3b_6 + a_2b_7 + a_1b_8 + a_0b_9$$

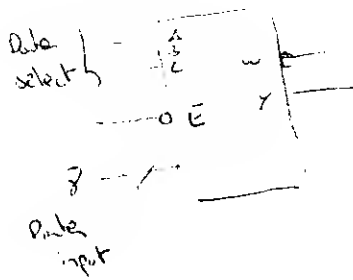
$$R_{10} = a_5b_5 + a_4b_6 + a_3b_7 + a_2b_8 + a_1b_9 + a_0b_{10}$$

$$C_{out}$$



WEEK 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

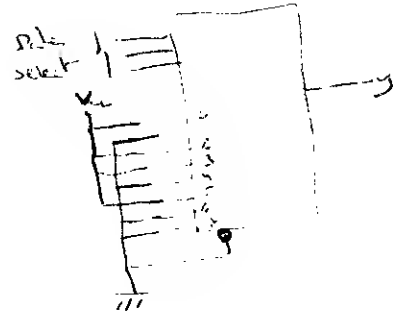
25) 74151 Data - $f = \sum m(0, 2, 3, 5)$



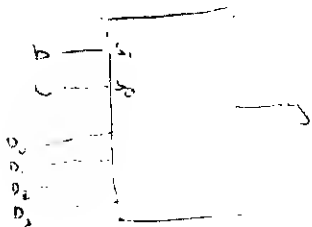
$$Y = D_0 \bar{A}\bar{B}\bar{C} + D_1 \bar{A}\bar{B}C + D_2 \bar{A}B\bar{C} + D_3 \bar{A}BC + D_4 A\bar{B}\bar{C} + D_5 A\bar{B}C + D_6 AB\bar{C} + D_7 ABC$$

$$f = \sum m(0, 2, 3, 5) = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}BC + A\bar{B}\bar{C}$$

$$\begin{aligned} D_0 &= 1 & D_1 &= 0 \\ D_2 &= 1 & D_3 &= 0 \\ D_4 &= 1 & D_5 &= 0 \\ D_6 &= 1 & D_7 &= 0 \end{aligned}$$



26) 4-to-2 decoder MUX eqn $f = ab + bc$

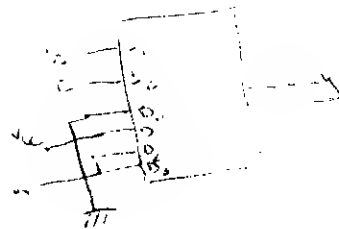


$$Y = D_0 \bar{a}\bar{b}\bar{c} + D_1 \bar{a}\bar{b}c + D_2 \bar{a}b\bar{c} + D_3 \bar{a}bc$$

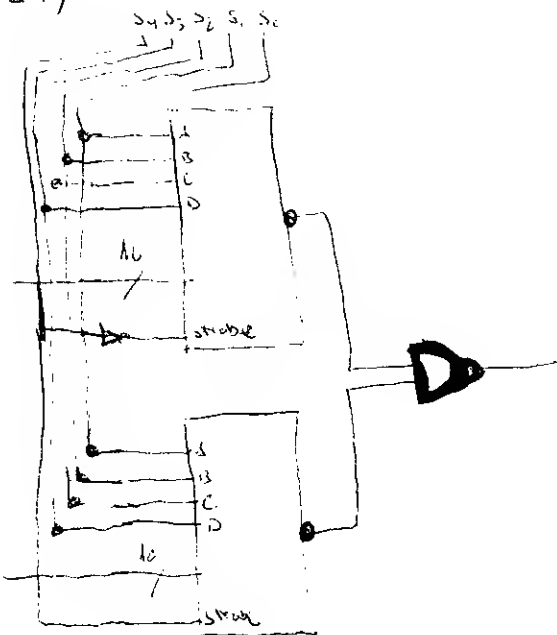
$$f = ab + bc$$

$$f = ab + bc = ab + bc$$

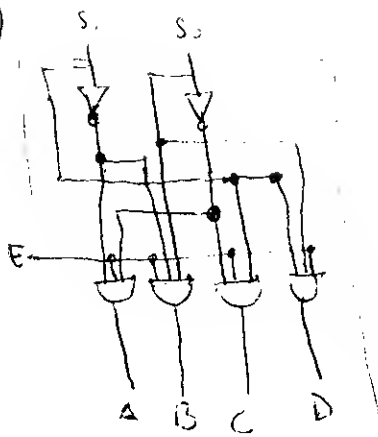
$$\begin{aligned} D_3 &= a \\ D_2 &= a \\ D_1 &= 1 \end{aligned}$$



24)

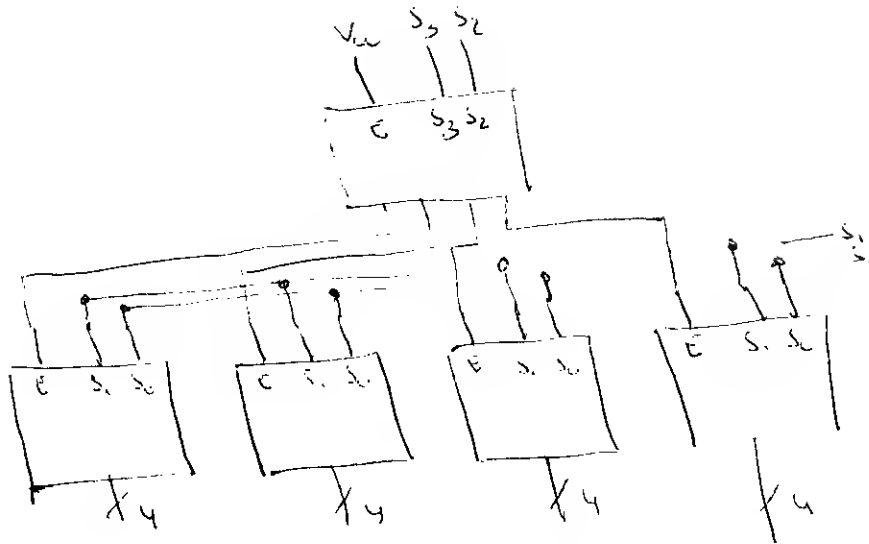


23)



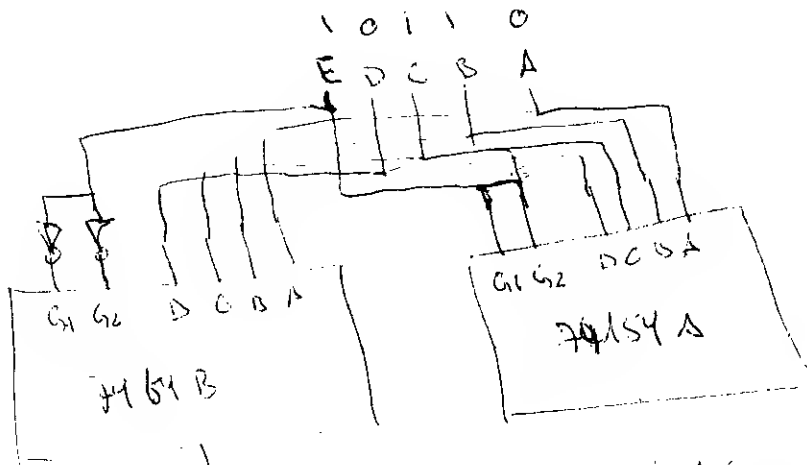
Z-4-12

C	A	S ₁	S ₂
0	1	1	1
1	0	1	1
1	1	0	1

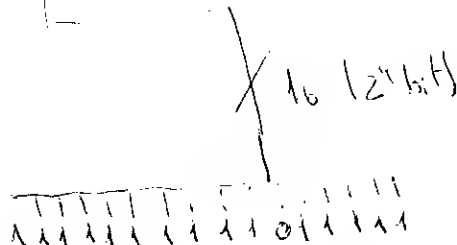


C	A	S ₁	S ₂
0	0	0	0
0	0	0	1
0	0	1	0
0	0	1	1
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	0	1
1	0	1	0
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	0
1	1	1	1

22)



74154 B based on the given data



16 (2⁴ bit)



30)

$$\begin{aligned}
 & \overline{X_4} \overline{X_3} X_1 \rightarrow \\
 & \overline{X_4} \overline{X_3} X_1 (\overline{C} \overline{B} X_3 + \overline{C} B \overline{X_3} + C \overline{B} \overline{X_3}) \\
 & \overline{X_4} \overline{X_3} X_1 (\overline{C} \overline{B} X_3 + C \overline{B} \overline{X_3}) \\
 & \overline{X_4} \overline{X_3} X_1 (\overline{C} \overline{B} X_3 + \overline{C} B \overline{X_3} + C \overline{B} \overline{X_3}) \\
 & \overline{X_4} \overline{X_3} X_1 (\overline{C} \overline{B} X_3 + C \overline{B} \overline{X_3}) \\
 & \overline{X_4} \overline{X_3} X_1 (\overline{C} \overline{B} X_3 + \overline{C} B \overline{X_3} + C \overline{B} \overline{X_3}) \\
 & \overline{X_4} \overline{X_3} X_1 \\
 & \overline{X_4} \overline{X_3} X_1
 \end{aligned}$$

C: $\overline{X_2} X_0$

$$\overline{X_4} \overline{X_3} X_1 + \overline{X_4} \overline{X_3} X_1 + \overline{X_4} \overline{X_3} X_1 + \overline{X_4} \overline{X_3} X_1 + \overline{X_4} \overline{X_3} X_1 + \overline{X_4} \overline{X_3} X_1$$

000 001 010 011 100 101